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ABSTRACT

The field tested instructional package introduces the student to industrial research and development. Defining behavioral objectives, the course description includes a media section, suggested classroom activities, and student evaluation materials, as well as the basic information section. Included is a working definition of research and development. The five steps of the scientific method of research and development are listed and explained along with six traits of a creative thinker. The package explains the role of research and development as used by industry to produce goods and services. (Author/MW)

AN INTRODUCTION TO RESEARCH AND DEVELOPMENT

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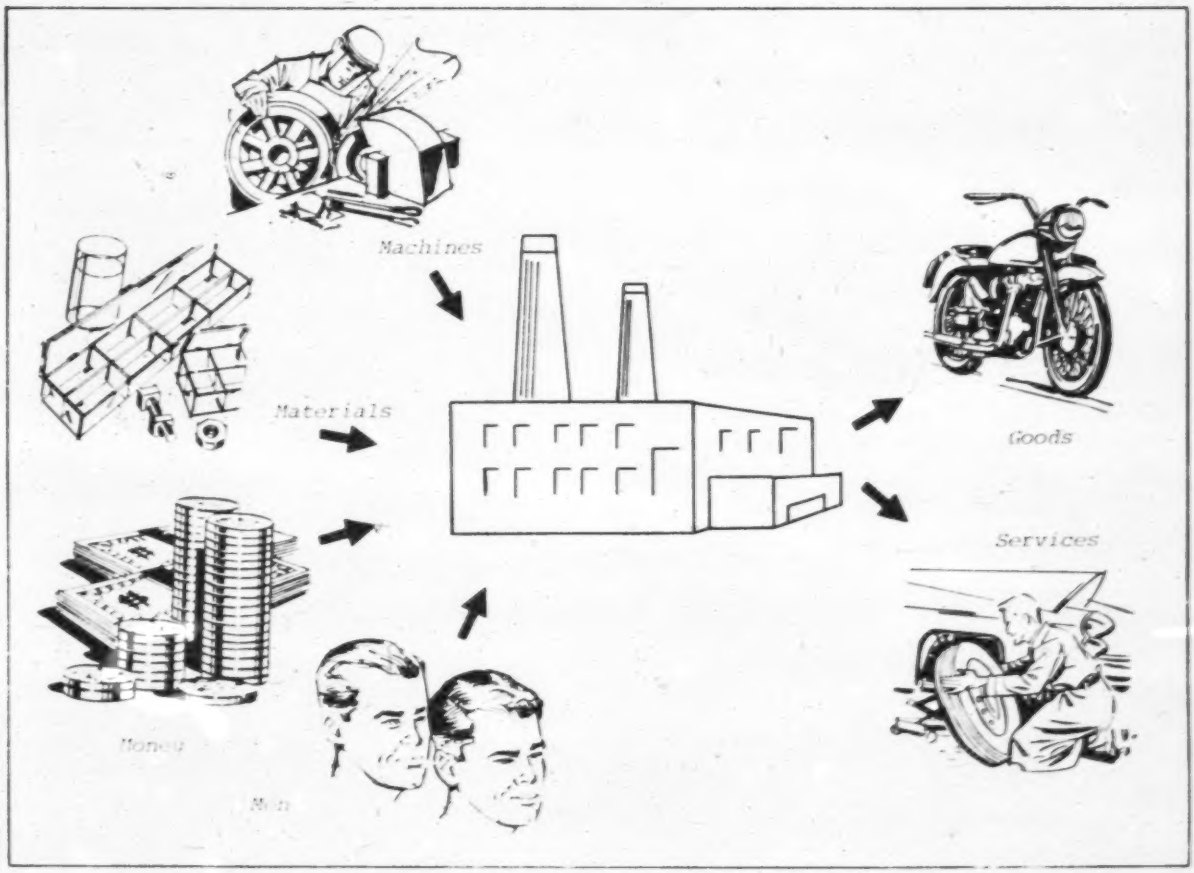

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

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Learning Activity Package

Prepared as an Aid in Implementing
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Improvement in Industrial Education, K-12

Research and Development

Junior-Middle High School

Pertaining to Field Objective Number One

"To work with the elements of research and development in order to gain an understanding of how they function in industry to produce goods and services."

Produced by

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RATIONALE:

What? One area of industry deals with finding new answers that meet the needs of man. This area of industry is called research and development. Why? Industry affects everybody on earth in some way or other. It has, and continues to change the way we live. Even people in remote areas of the world are not free from atmospheric changes. Research and development, concerned with finding new answers to meet the needs of man, is an important element of industry. Without products or services to sell, man would not have industry. Research and development in industry basically consists of using knowledge to develop products or services that can be sold. Man, through many centuries, has developed a 'best' system of studying problems. This system is called the 'scientific method'. The scientific method sets up rules on how to study any problem. The scientific method is the best way man has right now to find new answers. If we can understand how to use the rules of the scientific method, we can apply them to anything we do in our lives which involves problem solving. Why study research and development in industry? The knowledge and understanding gained should lead to a more productive and happier life for you.

Where are we? The study of research and development in industry is divided into five objectives. These should be studied starting with number one and working through number five for the best results. This package deals with objective number one.

Please turn to the next page and read the objectives carefully!!

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OBJECTIVES:

Terminal Objective:

Work with the elements of research and development to g
understanding of how they function in industry to produce g
services.

Enabling Objectives:

In writing and without assistance:

1. Define research and development
2. List the five steps in the scientific method of research and development.
3. List six traits of a creative thinker.
4. Briefly describe the role of research and development in industry.

Options: Read the self-test on the following pages and then check the following selections that apply to you.

___ If you feel you can meet the above objectives:

___ A. See the instructor for a teacher evaluation.

___ B. Take the self-test as a self evaluating device, then see your instructor.

___ If you feel you cannot meet the above objectives:

___ A. Take the self-test to see what objectives your studying should be based upon, then turn to the media section on page 4.

___ B. Skip the self-test and turn to the media section on page 4 to help you achieve the objectives.

Self-Test

1. Define research and development.

2. What are five steps for guiding research and development?

3. What are six traits of a creative thinker?

4. What does research and development do in industry?

MEDIA SECTION

Objective Number 1: Define research and development.

Optional Media:

___ 1. Dictionary

___ 2. Page 5 of this package.

Activity: Research and Development - I-1

Objective Number 2: List the 5-step plan for scientific research and development.

Optional Media:

___ 1. George Barr, Research Ideas for Young Scientists, New York; McGraw-Hill Book Company, 1958

___ 2. Lewis E. Lloyd, Techniques for Efficient Research, New York; Chemical Publishing Company, 1966.

___ 3. Read pages 5 thru 8 of this package.

Activity: Research and Development-I-2

Objective Number 3: List six traits of a creative thinker.

Optional Media:

___ 1. Lewis E. Lloyd, Techniques for Efficient Research, New York; Chemical Publishing Company, 1966.

___ 2. Read pages 8 thru 10 of this package.

Activity: Research and Development-I-3

Objective Number 4: Write what research and development does in industry.

Media:

___ 1. Read page 10 of this package.

Activity: Research and Development - I-4.

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INFORMATION SECTION

Define Research and Development

By definition, research is a 'systematic investigation to discover new facts that solve a problem.' A definition of development is, 'converting information or a product into a more useable form.' Putting the two words together gives them both a slightly different meaning - they now refer to a process of problem solving. A good definition for research and development is, "investigation and experimentation conducted for the purpose of arriving at a solution to an identifiable need."

We spend our entire lives solving problems, whether it's learning to feed ourselves or developing a lunar module. Since we have to be solving problems in order to stay alive, we might ask ourselves, "Is there a best way of solving problems?" The answer is "yes!" The 'best way' used to solve a problem is called 'the scientific method'. The scientific metho is a systematic way to solve a problem - any problem. This has been perfected over the last few centuries. In the distant past, problem solving was done by accident or by trial and error. If something worked out they used it; if not, they tried something else. Gradually man developed the system used today calle the scientific method of research and development. We will talk about this method and its five parts n

Five-Step Plan for Guiding Research and Development.

1. State the need.

The purpose for stating the need is to pin down exactly what you

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are trying to do. This will save time and aim you in the right direction.

Examples: To build a device that holds books.

To write a learning package on research and development.

To fasten two pieces of metal together.

The object is to determine what the need is and actually write down what you are trying to accomplish.

2. Assemble the facts.

Find out everything you can that will lead to a solution. Check with other people; look in school text books; search in the library. Examine all available information carefully. There have been millions of people thinking for a long time, maybe they have solved your problem and written about it. You want to learn as much about your subject as possible before going to the next step. A great thinker of this century, Albert Einstein, claimed to have said he had only two original thoughts in his life - the rest of the time he was learning the information that was available. What you want to do is bring yourself up-to-date on what has been done. To do this, you should analyze or investigate all of the data you can find that is concerned with the problem.

3. Find a solution.

This is what you are trying to do. Step one and two prepare you to find the solution. Most answers will be merely reorganizing what has already been done, into a form that will solve your problem. For example, if your research problem is "to build a device to hold books," you should assemble all the facts about bookshelves. You will probably

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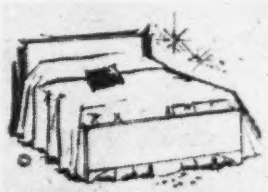
combine the features of several into one that you like. How should you go about deciding? One way is to look over the information you have assembled and make your decision.

A second way, one that many intelligent people use, is to "sleep on it." This process actually works! What you do is review the information you have just before going to sleep at night. Then go to sleep and let your mind organize the answer to your problem for you. It sounds silly, but this is a good method.



A third method of finding a solution to a problem that industry is now using is called 'brainstorming'. This is a process where several people get together and for a short period of time say whatever comes to their mind about the problem. One person writes on a chalk board what is being said. No criticism is allowed. Now matter how wild the idea is, it is written down. One idea may lead to other ideas. The brainstorming session should last for only a short period of time - say ten minutes to two hours - to be most effective. A session could be held the next day (after "sleeping on the information") and could be used to select the best solution to the problem. These are three processes that can be used for finding solutions to problems.

1. Select the best solution by looking at the facts you have assembled.

2. Sleep on the facts and choose the answer in the morning.
3. Brainstorm as a group and select the answer the next day.

The whole process of selecting a solution can be called 'creative thinking'.

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4. Test the solution.

You have picked what you feel is the best solution. Are you sure it is the best solution to your needs. Test it out. Find out if it meets the need you stated in step one. If not, go back to step three and find another solution. If the solution you have chosen does satisfy your need as stated in step one, you are ready for the last step in solving your problem.

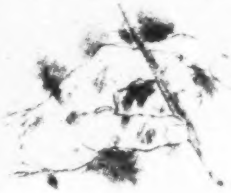
5. Take action.

The first four steps show you how to solve your problem, now you are ready to actually do it. If all the people in the world before us had only gone through the first four steps, no problems would have been solved. The world would have been full of people who know how to solve their problems, but they would still be sitting there with their problem. So you have to take action on what you have decided or all your research is wasted. That is, you have to 'develop' your 'research'.

Remember - 1. State the need.
2. Assemble the facts.
3. Find a solution
4. Test the solution.
5. Take action.

Six traits of a Creative Thinker

1. Ambitious - A creator is not afraid to try something that seems hard. When he feels the need to do something, he tries to do it.



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2. Perseverance - He keeps going even when results don't come right away.

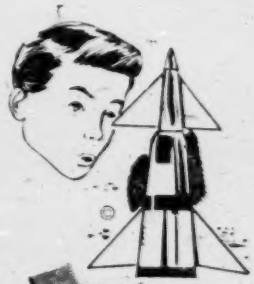
3. Enthusiasm - He really believes in what he is doing and is happy about it. This trait seems to help new ideas to appear.

4. Energy - He has energy to keep on working without becoming tired. This requires good physical health.

5. Knowledge - He seeks to find out what others have done. He works on his own to learn more.

6. Thinking - He uses his brain actively and enjoys doing it.

These are six traits that many good problem solvers have. You might ask yourself if you have these traits. If you don't, and want to develop them, here are some ways.



1. Try to understand yourself.
2. Carry a notebook and use it.
3. Develop skills in areas that interest you.
4. Read.
5. Think free - don't restrict yourself.
6. Be happy.
7. Daydream.
8. Question and predict things.

Another way to check yourself to see if you are research oriented is the S-D test. This is a test sometimes used in industry when selecting employees. "S" is for similar and "D" is for different. The S-type person, when he looks at a situation, sees the similarities first. The D-type person sees the differences first. For example, if both types of people were looking at several birds in a tree, the S-type would say they all have feathers, beaks and two feet. The D-type person would say they are different sizes, colors and shapes. What

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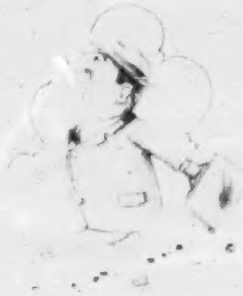
does this mean? The S-type has an inner urge to organize things. Research people are usually of this type.

The D-type is more of a businessman personality.

This test is simple and should not be taken too seriously, although it does show you a trait about yourself.

Research and Development in Industry.

We should be concerned with the role of research and development in industry. We won't be students all our lives, but we will have to find a job of some kind. The role of research and development in industry is to find a solution to a human need that can be sold at a profit. The size of the research and development department of a company depends upon the size of the company. It can safely be said that all companies must come up with new solutions or risk going out of business. The research and development department of a company uses the same scientific method we have been talking about. By using the five step approach to problem solving, you can increase your affectiveness and solve your problems right now. If you want to become a more creative thinker, you can work on that too. If you become good at research and development of your own problems, maybe someday you will want to work with it in industry. Hopefully the five step method will be a tool you can use to become a happier person.



More Information Sources for Research and Development

___ Norman Campbell, What is Science?; New York, Dover Publications Corp., 1953.

___ B.E. Noltingk, The Art of Research; New York, Elsevier Publishing Co., 1965.

___ George Barr, Research Ideas for Young Scientists; New York, McGraw-Hill Book Co., 1958.

___ Lewis E. Lloyd, Techniques for Efficient Research; New York, Chemical Publishing Company,Inc., 1966.

___ Garvin McCain & Erwin M. Segal, The Game of Science; Belmont, California, Brooks/Cole Publishing Co., 1969.

___ Phillip Goldstein, How to do an Experiment; New York, Harcoust and Bruce, 1957.

___ Carlo L. Lastrucci, The Scientific Approach; Cambridge, Mass, Schenkruen Publishing Company, Inc., 1967.

___ David Allison, editor, The Research and Development Game; Cambridge, Mass., The M.I.T. Press, 1969.

Activity: Research and Development - I-1 Name _____

Period _____

Define Research and Development

Directions:

1. Using the dictionary, look up both "research" and "development" and write the definitions of each.

2. Combine the two definitions into one definition of 'research and development' together.

3. Try using research and development as you understand it to figure out how to fasten two small boards together.

Activity: Research and Development - I-2 Name _____

Period _____

Learn the Five Step Approach to Research and Development

1. Write down the five-step approach to research and development.

2. Use the five-step approach to research and development to solve the problem of fastening two small boards together.

3. Find a way to hold two boards together temporarily.

4. Look at a vise and try to figure out how it works.

5. Think backwards trying to go through the steps the inventor of the vise went through when developing the vise. Fill in the information in writing for each of the five steps of problem solving.

Activity: Research and Development - I-3 Name _____

Period _____

Know six traits of a creative thinker

Directions:

1. Write down six traits of a creative person.

2. Read about famous people you know and look for traits in them that helped make them creative.

3. Look at yourself and see how you could become more creative. Try doing some of these things you have found.

Activity: Research and Development - I-4 Name _____

Period _____

Know the Role of Research and Development in Industry

Directions:

1. Look around to find a product you could make and sell. Go through the 5-steps of research and development and see if you can improve the product.

2. Try to find the percent of money that was spent by industry on research and development within the last five years.

3. Pretend you are an employee and your boss gave you a problem of building a device to hang up clothes. Could you develop a clothes hanger? Go through the 5-step plan and see what kind of device you would come up with for your boss.

Final Evaluation - Research and Development Name _____

Period _____

T or F 1. Research and development is investigation and experimentation for the purpose of arriving at a solution to an identifiable need.

2. List the 5-steps to scientific research and development in order.

1.	a. Assemble the facts
2.	b. Find a solution
3.	c. State the need
4.	d. Take action
5.	e. Test the solution

3. Pick 6 traits of a creative thinker.

1.	a. ambition
2.	b. sleepy
3.	c. afraid
4.	d. perseverance
5.	e. knowledge
6.	f. enthusiasm
	g. starved
	h. energy
	i. depressed
	j. thinking

T or F 1. The role of research and development in industry is to find a solution to a human need that can be sold at a profit.